dam or a Penrose drain with the gauze removed is inserted into the liver fossa and led out of the abdominal wall through a lateral stabwound. Stab-wound drainage lessens the danger of wound contamination. Drainage is not necessary if the ducts have been carefully isolated and identified, and if the hepatocystic ducts in the liver bed have been tied. Of course, if the gall-bladder is acutely infected or bile has exuded during the operation drainage is indicated.

POSTOPERATIVE TREATMENT

In the postoperative care of the patient nothing is given by mouth for at least forty-eight hours. A ten per cent solution of glucose in one per cent salt is given intravenously twice a day and normal salt subcutaneously so that the patient receives at least 3000 cubic centimeters daily for the first two days after operation. Fluids are then started orally and the patient is maintained on a fluid diet for one or possibly two days. Soft foods are given for the next week.

Flatulence is controlled by glycerin suppositories and a rectal tube. Enemas and flushes are avoided as much as possible. A large electric bake or turpentine stupe help a great deal and pituitrin is given when necessary. Fluid is not given by rectum unless it be salt solution, which is well absorbed, for it has been recently shown that glucose is not absorbed from the rectum. Fluids given by rectum stimulate reverse peristalsis and, therefore, increase flatulence.

This regimen has been most satisfactory and in this series eighty-eight consecutive gall-bladder operations are presented without a death (Table 1). Some of these patients entered the San Francisco Hospital with well-advanced lesions. There were four perforations, two gangrenes, and nine acute empyemas of the gall-bladder in this relatively small total series. The absence of operative mortality cannot continue, of course, but if it should remain low it would seem that our present methods are worthy.

450 Sutter Street.

FRACTURE DISLOCATIONS OF THE LOWER CERVICAL SPINE*

REPORT OF CASES

By H. W. SPIERS, M. D.
Los Angeles

DISCUSSION *by N. Austin Cary, M. D., Oakland; E. W. Cleary, M. D., San Francisco.*

THE progress of surgery in fractures and dislocations of the spine has lagged somewhat behind that of the extremities. Not so long ago a fracture of the spine was universally of grave import. If there were no cord symptoms it was good fortune; if there were no nerve root complications it was still better fortune, but the surgeon rather expected a high degree of impaired function and prepared the patient and his friends for a lifetime of at least partial disability.

PRINCIPLES OF REDUCTION SAME FOR FRACTURE OF SPINE AND EXTREMITIES

Accurate reduction of a fracture or dislocation of an injured extremity has become axiomatic, but this does not seem to be the case in the spine. The fundamental principles of fracture surgery apply equally to the spine. As such, traction and countertraction, placement of the distal fragment in line with the proximal, and immobilization, till healing has taken place, are just as applicable in fracture surgery of the spine as elsewhere.

Davis and Dunlop[1,2] have pointed out similar methods for reduction and realignment of fractures of the lumbar spine. Recent articles by Langworthy[3] and Taylor,[4] have demonstrated successful procedures for handling the cervical spine. Simultaneously, a method has been used by the writer for reduction and care of cervical dislocations and fractures, which seems worthy of consideration in that it has several points of advantage to both the patient and to the surgeon.

Neurological surgeons are quite agreed that actual cord destruction cannot be cured. They are also agreed that the actual amount of destruction cannot be told by the symptoms which immediately follow the injury. They are not agreed as to the value of radical surgery immediately following cord and nerve root damage. The consensus of opinion of the most prominent authorities is, that laminectomy is rarely justified by its results. Such surgery will not enter this discussion, since it is my experience that it holds out very little to such patients.

RELIEF OF PRESSURE ON SPINAL CORD OBJECT OF TREATMENT

The object of treatment is to relieve cord or nerve root pressure, and to immobilize the parts. It is my feeling and experience that reposition and maintenance of the displaced bones or fragments offers by far the most hope in minimizing both the immediate and remote results. It would seem beyond dispute that the trauma and pressure due to angulation, or to the narrowing of the bony spinal and root canals, is best relieved by the normal reposition of the bones or fragments which cause the pressure.

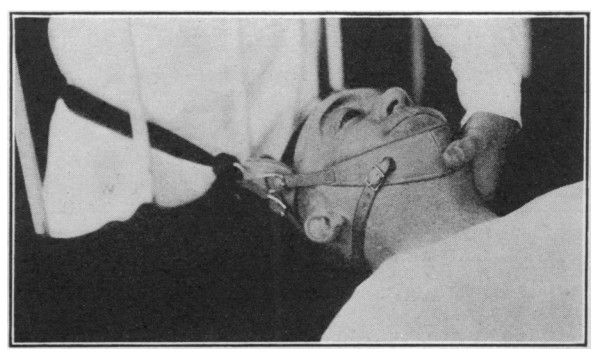

Fig. 1.—Sayre head sling in place with traction band about hips of operator.

* Read before the Industrial Medicine and Surgery Section of the California Medical Association at the fifty-ninth annual session at Del Monte, April 28 to May 1, 1930.

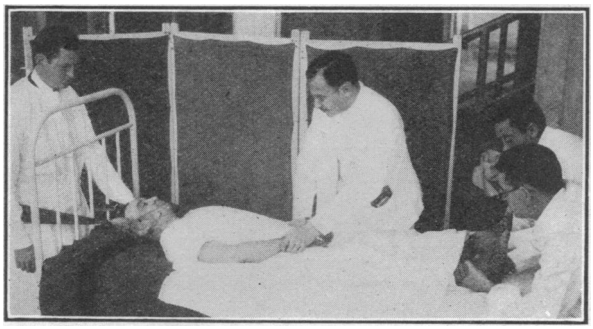

Fig. 2.—Traction and countertraction before manipulation.

A fracture dislocation of the cervical spine is most frequently caused by a fall on the head, flexing and twisting the cervical vertebrae violently beyond their normal range of motion. Little need be said of the mechanism of the injury. Any violence sufficient to lift even one articulating facet from the other causes considerable damage. It is my experience that the articulating facets are fractured more often than even the x-ray can demonstrate. This is reasonable when one considers the tremendous ligamentous support with which nature has provided the vertebrae.

The symptoms presented may be mild or grave, depending largely upon the amount of cord or nerve root damage. The more nearly the injury approaches the medulla the more serious the prognosis. Immediate death is frequent in injuries in the upper segment. Sensory and motor disturbances are wholly dependent on the amount of temporary or permanent damage to the cord or nerve roots. The symptoms vary from the gravest picture of total sensory and motor paralysis from the shoulders downward, to only a painful stiff neck or mild upper extremity neuritis. There can be no doubt of the diagnosis in the grave case, but in the less severe case only a roentgen-ray study will completely reveal it. Anteroposterior views are deceptive. Stereoscopic ones are but little better. Good lateral views are imperative and they are hard to get, particularly in the low cervical region.

All varieties of fractures and fracture dislocations may occur throughout the cervical segment. The atlas and axis, by their specialized shapes and functions, present many peculiar variations of damage. My clinical experience in this region has been limited, as few patients who sustain fracture dislocations in this area live for treatment. By far, the most frequent area in the cervical spine for such pathology to take place is that of the fifth, sixth, and seventh cervical vertebrae. Here, as one would expect, the greatest leverage takes place. The series that I will present later all took place in this region.

TREATMENT PROCEDURES

The method of treatment is simple in that the cardinal principles of reduction of fractures are followed. First, the patient, as soon as possible after the diagnosis is made, is anesthetized fully on a hard bed, the one in which he is going to remain. A pad is placed under the shoulders that the head may be manipulated and hyperextended without interference. Second, a head traction halter is placed on the head. This is attached at each side to a band running through the head of the bed and around the surgeon's hips. The surgeon, with his knees against the head of the bed, thus has powerful traction possibilities completely in his control and his hands are left wholly free. Assistants at the foot manipulate the patient's feet or arms for countertraction. Third, with the muscles completely relaxed by the anesthetic, a steady traction is begun. The surgeon, with his free hands can, if necessary, manipulate the vertebrae and head in any desired direction. Reduction is accomplished in the large majority of cases, without much traction and with moderate manipulation. I have tried to figure out in each patient just what manipulation is necessary to accomplish reduction with the least trauma. Theoretically, forward and lateral flexion of the head and neck away from the locked facet is correct. Practically, this does not always release the locked facet, a fact probably due to the impossibility of predetermining all the pathological factors present. A distinct snap, which often may be heard and, in my experience, always felt by the surgeon's hands, accompanies reduction.

A lateral x-ray film is at once taken at the bedside and developed. A point of advantage here, to both the surgeon and x-ray technician, is that the patient is relaxed and the head and shoulders are well separated. A good film is readily secured. If reduction is successful, the traction, already in place, is transferred to pulley weights. From five to six pounds is usually sufficient. Excess weight is unnecessary and adds to the patient's discomfort tremendously. Sandbags beside the head steady it and are helpful. The patient is left as he is for about three weeks, then a molded cast of the shoulders, neck, and head is made without in the least disturbing his position. This is immediately removed and a model made from it and a modified Thomas collar developed. The ordinary Thomas collar I have found not quite sufficient. It allows too much forward flexion of the head and neck. This has been overcome by carrying spring steel bands down the back to be attached to chest straps. The upright position, if not contraindicated by other disability

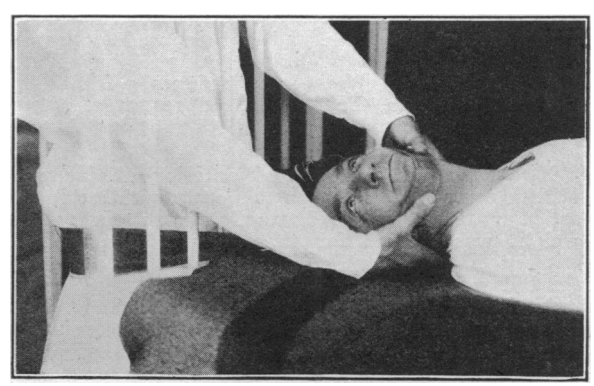

Fig. 3.—Traction applied. Manipulation of the neck by the operator's free hands.

factors, is now assumed. After a few weeks, physiotherapy is begun. The patient usually makes his maximum recovery in from four to six months.

The advantages of this method over others, advocated by recent textbooks and articles, seem to me about as follows:

1. The patient is treated in the bed in which he is going to remain permanently, almost as soon as seen, and the diagnosis made. Delay with increase of tissue damage if pressure exists, and the danger of loss of reduction by necessary change from table to bed, and careless handling, is obviated.

2. No cast is applied. The discomfort of such is considerable. Vomiting and retching in a neck cast after an emergency anesthetic has been given, with the patient usually unprepared, carries with it real possibilities of asphyxiation and pneumonia.

3. No specialized apparatus is necessary; everything needed can be secured almost anywhere. To apply a plaster neck and head cast which is at all satisfactory on a patient, requires much apparatus and expert knowledge of its use.

4. Reduction and immobilization is accomplished at the earliest possible moment, a fact that may mean immediate life-saving, as well as lessening the remote disability factors.

REPORT OF CASES

In a period of two years I have had seven cases. There have been three deaths—one the fourth day from respiratory paralysis with a completely crushed cord. One other, an insane patient, died in about four weeks after complete motor and sensory recovery. She took off her traction, fell out of bed and reproduced her lesion, dying shortly thereafter. The third lived many months, following a partial cord destruction, and died of bladder and kidney complications. The other four made complete anatomic and functional recoveries.

CASE 1.—R. M. Age, forty-three. Admitted to Los Angeles General Hospital July 21, 1928. The previous day, he was thrown from a car to the pavement, striking on back of neck and on left shoulder. He had immediate severe pain in back of neck, but did not lose consciousness. He got up, but could not move his head because of pain and rigidity of neck muscles. On entrance to the hospital he complained of pain in both arms, particularly in the left, with numbness throughout it, and marked weakness in abduction and marked tenderness over region of fifth cervical vertebra. The biceps reflexes were absent with reduction in the left deltoid response. There was slight impairment of tactile sensations, but no cord symptoms.

X-ray examination showed anterior displacement of fifth cervical vertebra on the sixth, with locking of articular facets. A head traction with six pounds weight was applied for three day by the resident without improvement. When he was seen on the third day an anesthetic was immediately given and reduction accomplished by horizontal traction and manipulation. An x-ray following, showed complete reduction. Three weeks later, a plaster collar model was made, and the collar was applied ten days later and patient allowed to be up. With daily physiotherapy treatment to the left arm and shoulder, there was rapid improvement in the left deltoid action. The function of the forearm and hand improved slowly. Six months after the injury the collar was discontinued. The patient, seen one year after the accident, had returned to his work with 90 per cent, or better, of full function.

* * *

CASE 2.—A. S. Age, thirty-four. Admitted to Los Angeles General Hospital August 20, 1928. This patient, who was insane, had on the previous day jumped from a moving car, striking on her head on the pavement. She was restless, noisy, and irrational, but there were no pathological reflexes with the exception of a suggestive Babinski. It was impossible to determine accurately motor or sensory involvement because of the patient's condition. It was evident that there was involvement of the nerve roots to the arms, but no cord symptoms.

The x-ray showed a forward displacement of the fifth cervical on the sixth, with locking of the articulating facets. The following day, under an anesthetic, reduction was accomplished by horizontal traction and manipulation. Continuous six-pound traction was applied. She progressed nicely for about three weeks. All sensory and motor disturbance seemed to have cleared up. During the night she removed her traction, got out of bed and was found on the floor. Examination showed she had a complete paralysis of the legs, absent knee-jerks, and positive bilateral Babinski reflexes. There were only slight motor responses in the upper extremities. Urinary retention was present. X-ray check-up demonstrated redislocation of the fifth cervical vertebra. She died at the end of the fourth week. Autopsy examination report stated hypostatic pneumonia with cord degeneration below region of the fifth cervical vertebra.

* * *

CASE 3.—E. M. Age, forty-nine. Admitted to Los Angeles General Hospital October 7, 1928. He was in an auto accident the previous evening and remembered nothing of how he was injured. Examination showed an almost complete motor and sensory paralysis from the shoulders downward. Both arms could be abducted slightly; sensation was present over a limited area in the upper arms.

The x-ray showed an anterior luxation of the fifth cervical on the sixth, crushing of the superior articular facet, and lateral mass on the left side of the sixth cervical. On the second day an anesthetic was given and reduction accomplished by horizontal traction and manipulation; traction continued with six pounds weight. There was considerable return of motor and sensory function in the arms and a lesser amount in the lower extremities. There was bladder and bowel incontinence. At the end of about one month he began to fail and became irrational at times. He died at the end of the nineteenth week. The autopsy showed a terminal pleuropneumonia; also partial degeneration of the spinal cord from the level of the fourth cervical downward.

* * *

CASE 4.—J. C. Age, sixteen. Referred by Dr. Elmer Anderson. Entered Hollywood Hospital November 1, 1928. He was injured in a football game about 3:30 p. m. and was seen at the hospital forty-five minutes later. He was rational. He stated that he immediately lost the use of his arms and legs following his accident. There was a complete flaccid paraplegic and complete anesthesia below the sixth cervical cord segment. Reflexes were absent.

The x-ray showed a forward dislocation of the fifth cervical with articulating facets interlocking. Under immediate ether anesthetic, reduction was accomplished in about ten minutes by horizontal traction and manipulation. Check-up x-ray showed complete reduction of dislocation, and head traction was continued with five pounds weight. The following morning the upper arms could be moved and sensations as far as the elbow were present. Three days later

he developed a sudden respiratory paralysis and died. The autopsy showed extensive cord necrosis in the region of the fifth cervical vertebra.

* * *

CASE 5.—C. S. Age, thity-six. Referred by Dr. William T. Cain. Admitted to Hermosa Hospital December 31, 1928. Injured in automobile accident December 28, 1928. The symptoms were: pain and rigidity in the neck, numbness in right index finger and thumb, weakness of entire right arm, and pain along outer border of right arm.

The x-ray showed a forward dislocation of fifth cervical on the sixth. Six days following the accident, under ether anesthesia, reduction was accomplished by horizontal traction and manipulation. Traction was continued till the end of the third week. when a collar was applied. At this time the arm and hand symptoms had completely disappeared. An x-ray showed callus along the anterior border of the fifth and sixth vertebral bodies. The collar was worn for four months and discarded. He has remained well, with full function to date.

* * *

CASE 6.—M. C. Age, thirty-four. Referred by Dr. Charles H. Peppers. She was injured the previous evening by falling against a dresser. There was immediate pain and muscle spasm in the neck and pain and numbness in the left arm and hand.

X-rays showed a forward dislocation of sixth cervical on the seventh, with comminuted fracture of anterior border of sixth cervical vertebra and fracture of spinous processes of sixth. Another surgeon attempted head traction and manipulation under anesthesia. X-ray check-up showed improvement, but not complete reduction. There was a slight improvement in arm sensations during next three days. On the fourth day, again under ether anesthesia, with horizontal traction and manipulation, reduction was accomplished. Check-up x-ray showed complete reduction. There was marked relief of arm symptoms the following day. Head traction was continued with decreasing weight for three weeks, when a collar was fitted and the patient was allowed to get up at the end of the fourth week. Six months following injury, the collar was discontinued and the patient returned to her former occupation without disability or symptoms.

* * *

CASE 7.—E. W. Age, fifty-eight. Referred by Dr. H. E. Peterson. Was seen at San Fernando Hospital September 11, 1929. Was in automobile collision the previous evening. His head was not hit, but was whipped forward violently. He had pain and numbness in right arm and hand, and pain and rigidity in the neck.

X-ray showed forward dislocation of fifth cervical vertebra on the sixth. Under anesthesia, with horizontal traction and manipulation, reduction was accomplished, as revealed by check-up x-rays. This was followed by head traction with five pounds weight and was continued for three and a half weeks, when a modified Thomas collar was fitted and patient was allowed up. Two months later, collar was still being worn and patient was still under treatment. No neuritis was present. He is now caring for his business and is apparently cured.

CONCLUSIONS

1. It would seem from this small series that fracture dislocations of the cervical spine can be reduced and reduction maintained by a simple method.

2. That the danger of the method is at least no greater than others, and has several points of increased safety and comfort.

614 Westlake Professional Building.

REFERENCES

1. Davis. J. Bone and Joint Surg., Vol. xi, p. 133, January 1929.

2. Dunlop. J. A. M. A., Vol. xciv, No. 2, January 11, 1930.

3. Langworthy. J. A. M. A., Vol. xciv, No. 2, January 11, 1930.

4. Taylor. Ann. Surg., Vol. xc, No. 3, September 1929.

DISCUSSION

N. AUSTIN CARY, M. D. (2939 Summit Street, Oakland).—The method of applying traction in reducing fracture dislocations of the cervical spine is a valuable modification of methods which we have used and observed for a number of years.

I would like to emphasize the importance of a thorough knowledge of the mechanics of production and reduction of these injuries. This is essential before instituting traction on the cervical spine, as ill advised and purposeless manipulation will give some serious complications.

We prefer to immobilize these injuries immediately after manipulation in a quilted cotton collar instead of using leather or plaster of Paris. These collars are made by enclosing cotton of standard roll thickness between layers of plain rolled gauze, four to six inches in width and about five yards in length. This is then rolled into a bandage and successive layers are wrapped about the neck from below upward, building up a good support. These collars are then snugged up with an additional layer of gauze or outing-flannel bandage. They are comfortably worn and furnish adequate immobilization, and roentgenological check-ups can be made without their removal, a factor of considerable importance in injuries of this region.

*

E. W. CLEARY, M. D. (490 Post Street, San Francisco).—Doctor Spiers' paper is a valuable contribution to the literature on treatment of fracture dislocations of the cervical spine. His method is simple, practical, and efficient. There seems little to add to what he has said.

At times I have found it expedient to put on a plaster collar under traction as soon as reduction is accomplished. This may prevent, in the case of an irresponsible patient, such an accident as occurred in the case of the insane woman who took off the traction and fell out of bed with a fatal result.

Doctor Spiers' method of applying traction during reduction by means of a bandage circling the surgeon's body, I think particularly clever. I shall use it in the future. I note that Doctor Spiers uses the chin-occiput bearing for traction application. I prefer the brow-occiput application, as I find it equally simple and effective and it has the advantage of leaving the jaw free for mastication.

*

DOCTOR SPIERS (Closing).—I wish to thank both Doctors Cary and Cleary for their discussion of this paper.

Regarding the quilted cotton collar method mentioned by Doctor Cary, I have been rather inclined to feel that one could hardly be certain of its efficiency. In a case where there is no tendency to recurrence of displacement, it would undoubtedly be more comfortable.

Doctor Cleary brought out the fact that the plaster cast might be more expedient in the irresponsible patient. I agree with him. My insane case with a fatal termination demonstrates this point well. I am glad the brow-occiput halter was mentioned. It has been my custom to alternate these halters from day to day. Neither, in my experience, is wholly comfortable.